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Bitcoins as a determinant of stock market movements: A comparison of Indian and Chinese Stock Markets

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Abstract.*The present paper aims to examine the relationship between price movement of cryptocurrency (Bitcoin) and stock exchange movements of two major global economies i.e. India and China. 1133 number of observations on daily basis were taken from 1st January 2015 to 29th November 2019 and analysed using statistical software E-views. Statistical techniques like Granger Causality, Johnsen Co-integration and VECM have been employed to achieve the objective of the paper. The empirical results of the paper depict that long run relationship exists between Bitcoin and stock exchanges of India and China. Sensex has the unidirectional causality with Bitcoin. The significant t-statistics imply an influential role of Sensex in Bitcoin price movement. The results further indicate that there is no evidence of any causal relationship between Bitcoin and Chinese Stock exchange, which suggests a better risk-return mechanism for the global investors and policy makers. The findings of the paper can be imparted as guidelines for the global investors for diversifying their portfolios.*

Keywords: Bitcoin, Sensex, SSIC, Granger causality, VECM.

JEL Classification: F33, F43, G15, G41, N25.

Introduction

The current business scenario is marked by the paradox of convergence and disruption forces. Globalisation and revolution in information technology bring the snippets of information and glimpses of global events to our breakfast table and bedrooms. These convergent forces have transformed the world into single global village. The global financial markets do not remain galvanized from these forces. In todays' multifaceted global economic environment, the international financial market plays a vital role. The rise of crypto-currencies has provided a new dimension to the global financial trade. Crypto-currencies provide an easy-to-use and digital substitute to the global fiat currencies.

These virtual currencies have drawn the attention of global investors, central regulators and financial analysts. Hileman and Rauchs (2017) observed a prominent upsurge and exponential development in market of crypto-currency that further leads to rise in trading volume of these virtual currencies like bitcoin. Li and Wang (2017) observed the gradual increase in sphericity of crypto-currencies in the global financial markets even acknowledging after their uncertain future. Katsiampa (2017) examined that high return is the prime reason behind high volatility in crypto-currency price movement. Kim (2017) revealed the cutting edge of bitcoin trading over the conventional currencies because of their low cost of transaction.Bouri et al. (2017) described the hedging property of crypto-currencies, such as, Bitcoins against the uncertainty in foreign exchange market. Dyhrberg (2016) illustrated the hedging quality of Bitcoin against stocks, foreign currencies and traded commodities and emphasize on its role in hedging systematic risk in context of market risk. Glaser et al. (2014) investigated the financial asset characteristic and currency characteristics of Bitcoin. The results of the study revealed their inclination towards the speculative characteristics of financial assets of Bitcoin rather than its currency characteristics in context of buying services or commodities.

After observing the course of above discussed research studies, the present research work dives a little deeper in the context of trading of crypto-currency and in global stock indices. The present paper aims to investigate the existence of relationship between Bitcoin price movement and stock indices of global emerging markets i.e. India and China. This paper also potentially contributes to the existing literature in the context of co-integration of crypto-currency market and financial markets of emerging economies.

The remaining paper has been structured as follows. Section 2 presents the literature review based on the previous studies done on the nature of relationship between cryptocurrencies and stock indices. Section 3 encompasses the research framework and the description of various statistical tools devised for analysis. Section 4 depicts the statistical results and their interpretation in the context of objectives of the study. The final section, Section 5 concludes and summarizes the findings and implications of the study.

Literature review

Carrick (2016) argued about the idiosyncratic characteristics of Bitcoins that enhance its appropriateness for trading in global financial markets.

Van Wijk (2013) examined the impact of global stock indices on price of Bitcoins while trading. The study found a significant influence of Dow Jones Index on Bitcoin Prices.

Dirican and Canoz (2017) studied about the impact of Bitcoin on the decision-making behaviour of investors in terms of stock indices. They examined the existence of co-integration level between Bitcoin and US and Chinese stock indices. The positive empirical results of the study support the presence of co-integration and provide the solidity behind the significance impact of Bitcoin price on the long run investment behaviour of global stock investors.

Jin and Masih (2017) empirically evaluate the correlation between return from Bitcoin trading and Malaysia's stock market. They studied the data varying between January 2013 and January 2017. The statistical output shows a negative correlation between the Stock exchange and Bitcoin price movement. The results of the study imply the significance of Bitcoins in diversifying the investment risk and enhance the portfolio return consisting Bitcoin as a part of portfolio.

Ayesian et al. (2019) studied the volatility pattern of Bitcoins traded in financial markets and empirically explored the hedging property of Bitcoins against the international geopolitical risks.

Yarovaya et al. (2016) raised their concern about the existence of speculation bubble in crypto-currency such as Bitcoin and stated it as a significant reason behind the weak financial stability as compared to equity and other various financial tradable assets.

Phillip et al. (2018) studied the properties of various crypto-currencies and reported a unique risk return trade off as compared to other financial assets like stocks, bonds that are traded in global financial markets.

Baek and Elbeck (2015) analysed high volatility among crypto-currencies and states the employability of Bitcoins for speculation while investing.

Corbet et al. (2018) studied the nature of relationship between various financial assets traded in stock market and crypto-currencies. The results of the study reveal the use of crypto-currencies in diversification for investors having short run investment period.

Kurka (2019) investigated the degree of co-integration between crypto-currencies and stock indices. The empirical results of the study documented a low degree of co-integration between the stock market indices and various global crypto-currencies.

Gil-Alana et al. (2020) studied the degree of co-integration between six crypto-currencies and global stock indices and found no co-integration between the understudy variables. They also reported the application of crypto-currency as financial instrument used for diversification in financial portfolios. Most of the previous studies examined the degree of

co-integration between crypto-currencies and stock market indices, but very rare studies made attempt to examine the existence of long run relationship between major crypto-currencies and stock market indices of emerging economies.

Research gap/Problem formulation

The above conversed review of the literature shows that major chunk of previous studies have focused on examining the relationship of Bitcoin with stock markets of developed economies. No specific emphasize was given on emerging economies. The time period taken for the studies was small or was on weekly basis. So major section of studies was not seemed to catch the real nerve of movement. The present paper aims to bridge this gap in the literature by examining the nature of relationship between bitcoin price movement and movement of stock exchanges of global emerging economies i.e. India and China.

Research framework

To examine the inter relationship between stock indices of emerging economies i.e. India and China with Bitcoin price movement, the daily data of Sensex (Bombay Stock Exchange), SSIC (Shenzhen Securities Information Company Ltd.) and Bitcoin Trading have been taken. The time span for the analysis was from 1st January 2015 to 29th November 2019. Total 1133 number of observations have been analysed during the said period. The requisite data was extracted from Yahoo finance. Various econometric tools have been applied on the data through Statistical software E-views, the brief description of which is given in the ensuing paragraphs.

Augmented Dickey Fuller (ADF) Test

Before applying the econometric tools, the foremost step is to analyse the stationarity of the given data. As most of the economic series are non-stationary and have unit root at raw level.

Dickey (1976) and Fuller (1976) documented that in the presence of unit root in the series, the results of Ganger Causality Test and VAR model shows a biasness and diminish the accuracy of other statistical tests. Granger and Newbold (1974) reported that by using non stationary series for analysis, the statistical output will be spurious. To avoid the use of non-stationary series, first difference of the series can be taken to transform non stationarity to stationarity one. Augmented Dickey Fuller (1979) test is applied to investigate the stationarity of the time series data under present study.

Null Hypothesis (H_0) – Series has unit root or Series are non-stationary.

Alternative Hypothesis (H_1) – Series has not Unit root or series are stationary.

Johansen Co-integration Test

Johansen (1988) co-integration test is employed to ascertain the existence of long run relationship between the variables.

- Null Hypothesis (H_0) – Long run relationship does not exist between Bitcoin and stock indices of emerging economies.

- Alternative Hypothesis (H_1) – Long run relationship between Bitcoin and stock indices of emerging economies.

Granger causality test

The major implication of Granger causality is to examine the direction of causality between two variables. Whether unidirectional causality, bi directional causality or no causality exist between two variables. The Granger Causality Test is performed at 5% level of significance.

- Null Hypothesis (H_0) – There is no Granger Causality between Bitcoin and stock indices of emerging economies.
- Alternative Hypothesis (H_1) – There is no Granger Causality between Bitcoin and stock indices of emerging economies.

If p-value lies above significance level then null hypothesis will not be rejected and vice versa.

VECM

If the results confirms the co-integration between under study variables then it may lead to ensure the long run relationship between the variables. Vector Error Correction Model (VECM) is applied to examine the long run relationship among variables.

Results and discussion

The outcome of the data analysis being carried out has been discussed in this section as follows.

Stationarity of data

To examine whether the series are stationary or not, ADF and P-P test are applied. At the raw level, the series are non stationary. To transform the data into stationary, first differences of the series are taken. If the p-value for ADF and P-P test are more than 0.05 Null hypotheses is accepted at 5% level of significance.

The following table presents the statistics related to stationarity of the data series.

Table 1. *Stationarity statistics*

Statistics Test	Variables	At Level			
		Intercept		With Intercept and Trend	
		t-statistics	p-value	t-statistics	p-value
ADF Test	Bitcoin	-0.8556	0.8022	-1.2041	0.9084
	Sensex	-0.3168	0.9199	-2.7179	0.2294
	SSIC	-2.0947	0.2470	-2.6476	0.2591
Phillips-Perron Test	Bitcoin	-0.8746	0.7964	-1.3276	0.8804
	Sensex	-0.2901	0.9238	-2.7365	0.2219
	SSIC	-2.1371	0.2302	-2.7009	0.2364

Source: Author's own work in Eviews.

Table 1 depicts the statistical value of unit root test to analyse the existence of stationarity in the given data series.

The table shows the value of ADF and Phillips-Perron Test value at both intercept and without intercept and Trend level. At both the levels, the p-values are higher than the

significance level of 5% (p vale > 0.05). It leads to acceptance of the Null hypothesis that signifies the existence of unit root in the data series.

The statistics related to stationarity of first differenced data series has been shown in the Table 2:

Table 2. *Stationarity statistics at first difference*

Statistics Test	Variables	At First Difference			
		Intercept		With Intercept and Trend	
		t-statistics	p-value	t-statistics	p-value
ADF Test	Bitcoin	-33.0288	0.0000	-33.0224	0.0000
	Sensex	-31.7338	0.0000	-31.7320	0.0000
	SSIC	-31.9754	0.0000	-319637	0.0000
Phillips-Perron Test	Bitcoin	-33.0349	0.0000	-33.0284	0.0000
	Sensex	-31.6957	0.0000	-31.6953	0.0000
	SSIC	-31.9631	0.0000	-31.9419	0.0000

Source: Author's own work in Eviews.

The Table 2 shows the statistical output of unit root test after taking the first difference of the data series. The empirical results indicate the value of ADF test and Phillips-Perron Test at intercept level as well as with intercept and Trend level.

The lower p-values (p values <0.05) in both ADF and P-P test imply the rejection of null hypothesis. It confirms the non-existence of unit root in the series and thus confirms the stationarity of the data.

Examining long term relationship among variables

The long term relationship among the study variables was studied using the Johansen co-integration test, the results of which are shown in the ensuing table:

Table 3. *Long term relationship among variables*

Hypothesized No. of Cointegrating Equations (CEs)	Eigenvalue	Unrestricted Co-integration Rank Test (Trace)			Unrestricted Co-integration Rank Test (Max-Eigen)		
		Trace Statistics	0.05 Critical Value	Prob.	Max-Eigen Statistics	0.05 Critical Value	Prob.
None*	0.186469	609.2088	29.7970	0.0001	232.5798	21.1316	0.0001
At Most 1*	0.161801	376.6290	15.4947	0.0001	198.9145	14.2646	0.0001
At Most 2*	0.145888	177.7145	3.8414	0.0000	177.7145	3.8414	0.0000

Source: Author's own work in Eviews.

The empirical output of Johansen co-integration test shows that the values of trace test statistics and maximum eigen value statistics are higher than critical values at 5% level of significance of both tests. It leads to rejection of null hypothesis. Thus, it gives evidence that long run relationship exists between the Bitcoin price movements and Indian and Chines stock indices.

As the long run equilibrium relationship exists between the variables under study and the data series under study have been converted from non-stationary to stationary, we will employ Vector Error Correction Model (VECM) and Granger causality statistical test to examine the causal relationship among the variables.

Verifying direction of causality

Granger causality statistical test shows the level of relationship among Sensex and SSIC stock indices with Bitcoin price movement. The above Johansen Co-integration test confirms the existence of long run relationship between Stock market exchange movement and bitcoin price movement. The table below shows the output of Granger Causality Test to examine the nature of relationship i.e. whether the causality between variables exists and whether the existing causality is unidirectional or bidirectional. The results of this test are shown below.

Table 4. *Results of pairwise Granger causality test*

Null Hypothesis	F Statistics	Prob.	Remarks
FDBITCOIN does not Granger Cause FDSSIC	0.1051	0.9002	No Causality
FDSSIC does not Granger Cause FDBITCOIN	0.2747	0.7598	No Causality
FDSENSEX does not Granger Cause FDBITCOIN	3.4914	0.0308*	Unidirectional Causality
FDBITCOIN does not Granger Cause FDSENSEX	0.8540	0.4260	No Causality

Source: Author's own work in Eviews.

The statistical table portrays the existence of causality between Bitcoin and stock indices of India and China. The statistical output of p-value between Bitcoin and China's stock Indices is higher than significance level of 5 percent. That means we accept the null hypothesis. It confirms the fact of non-existence of causality between Bitcoin and SSIC. The p-value for FDSENSEX does not granger cause FDBITCOIN is 0.0308 which is lower than the significance level of 0.05. It leads to rejection of null hypothesis which signifies that Sensex causes a fluctuation in price movement of Bitcoin. It shows a unidirectional causality between Sensex and Bitcoin as Bitcoin does not cause any fluctuation in Sensex stock indices.

This relationship has been further explored using the Vector Error Correction Model and has been discussed below.

Measuring effect of Sensex movements on Bitcoin

As the statistics depicted in Table 4 shows that Sensex has unidirectional causality with Bitcoin price movement, so we run Vector Error Correction Model between Bitcoin and Sensex. VECM examines whether the effect of Sensex on Bitcoin is significant or not. Bitcoin has been taken as dependent variable and Sensex as Independent variable while executing VECM. These results have been shown in the table given below.

Table 5. *Results of Vector Error Correction Model*

Parameters	t-Stats	r-square	Adjusted r-square
Values	14.0778	0.4229	0.4214

Source: Author's own work in Eviews.

The Table 5 depicts causality in bitcoin due to Sensex. The r-square (0.4229) indicates that 42.29 percent of causality in Bitcoin movement is due to Sensex. The results show a significant t-value (14.0778) being higher than 2.58 (t-value at 1% level of significance).

Regression equation

D (FDBITCOIN) = -0.0007 + 1.000 x FDBITCOIN (-1) + 5.287 x FDSENSEX (-1)

The above statistical results indicate that with one percent change in Sensex, the bitcoin movement increases by 5.287 percent.

Conclusions and implications

The empirical results of the study show that SSIC stock index fluctuation does not have any influence on the fluctuation in Bitcoin price movement. It shows they are independent from each other. No causal relationship exists between these two. On the other side, Sensex has significant influence on the volatility of Bitcoin.

These results carry a significant weightage from investors point of view. It further implies the chronological movement order in time series data in the case of Sensex and Bitcoin. The unidirectional causal effects between Indian Stock exchange and Bitcoin depends upon the fiscal and monetary economic policies, pen down by the policy makers.

The results of the present study are found on the same lines as of previous studies (Diricanand Canoz, 2017; Kurka, 2019;Corbet et al., 2018). The results indicate the opportunity available in global portfolio diversification for investors.

The study implies that investors can diversify their portfolio by investing in SSIC and Bitcoin as both are independent and any fluctuation in one does not generate any volatility in the other. In the Indian stock market context, investors need to be cautious while diversifying their investment by investing in Indian Companies and Bitcoin as increasing the volatility in Indian stock market leading to enhanced fluctuation in Bitcoin Price movement.

Thus, the global investors can enhance their risk return diversification by adopting a balanced approach in their portfolio while taking crypto-currencies as a part of investment.

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